

CLAIMS

CLAIM 1. I claim as my invention a shellfish nursery stock container consisting of two framed mesh sheets fastened together and sometimes spaced apart by a combination of shims (mesh, solid and/or compressible) such that the depth of the frame is adjustable to both accommodate the shellfish growth and hold the shellfish so they will not be overly jostled by high flows of water. (Figure 3)

CLAIM 2. I claim as my invention a shellfish growing device (FLUPSY) with a pivoting vane used to obstruct and bind a flow of water such that it is forced up through a separate mesh frame which contains shellfish. The pivoted vane accommodates a change in the tidal flow direction. (Figure 1)

CLAIM 3. I claim as my invention a shellfish growing device (FLUPSY) with the ability to work while moored in series, bow to stern. This is accomplished by having water exit on the sides above the bottom plain of the mesh shellfish container and also by an approximately upright panel perpendicular to the current to block the flow of water above the bottom plain of the mesh shellfish container at either bow or stern of the FLUPSY. This prevents the exit water of an up-current FLUPSY from pressing down upon the exit water of the next FLUPSY in the series. Descending side panels extend below the mesh shellfish container to inhibit the exit water from flowing down into the intake of next FLUPSY. (Figure 1)

CLAIM 4. I claim as my invention a shellfish growing device (BUPSY) with a pivoting mesh container (not a separate vane) used to obstruct and bind a flow of water such that it is forced through the mesh frame which contains shellfish. The pivot accommodates a change in the tidal flow direction. (Figure 2)

CLAIM 5. I claim as my invention a shellfish growing device, a TWELLER (Two Way upweller/downweller) with opposing flexible scoops opening on both the up-estuary and down-estuary moored ends of the device. The shellfish are placed in a roughly horizontal mesh

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container between the two scoops. On the changing of the tide the scoop that was an inbound scoop becomes an outbound cowling and the flow through the mesh changes direction so the mesh and scoop/cowls will tend to clear themselves of fouling – the device oscillates between up-weller and down-weller. (Figure 11)

CLAIM 6. I claim as my invention the premarket hypersaline treatment of marine products (feed ingredient products and human consumption products) to enhance the production of osmoregulator chemicals.

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CLAIM 7. I claim as my invention a water filtering device in which small fish and crustaceans that are captured between the filter panels such that they must clean the mesh panels or starve. This device and cohort emulates the self cleaning behavior of the marsupium used in freshwater mussel reproduction. See Figure 18

CLAIM 8. I claim as my invention a device, a BUPSY, consisting of a shallow mesh envelope with a length to width ratio of 3 or greater; that has an opening along one long edge, that has a strong-back and closure device bound to that opening edge. The strong-back is given floatation sufficient to buoy the assembly and the shellfish contained therein. The assembly is anchored so that it may maintain a position just off the bottom with the strong-back horizontal and normal to the usual current. See Figure 17

CLAIM 9. I claim as my invention a grounding tolerant current capturing device that is able to clear itself of incoming sediment, and commonly experienced debris and vegetation. The device is scoop of flexible fabric with flexible deep and leading edges. The scoop has portions of its small end left open so that a portion of the captured water will exit the scoop in an accelerated fashion carrying the debris and sediment with it. Since the deep and leading edges of this scoop are flexible the scoop may touch bottom with much lower probability of damage and operational disruption. (Figure 13)

CLAIM 10. I claim as my invention a device and process that maintains and develops water channels by means of an array of foils that direct and accentuating natural bottom scour and transport in the desired direction and inhibits scour and transport in the undesired direction. See Figure 19

CLAIM 11. I claim as my invention the shellfish reef geo-structures constructed from salt marsh and netting reinforcement. See Figure 16

CLAIM 12. I claim as my invention a soup made from cooked seaweeds as a nutrient and water conditioner for filter feeding shellfish and phytoplankton.

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CLAIM 13. I claim as my invention the pre-ship "Seaweed Soup" 'finish' feeding of clams and oysters to ensure their table quality and guarantee that the clams or oysters are sweet tasting, fat and safer to eat raw. This finish feeding purges some natural phytoplankton can impart a bitter after taste.

CLAIM 14. I claim as my invention the addition of calcium to seaweed soup to increase its gel strength and solidify it so that it can be a slow release food for aquatic life that has enhanced palatability and antibacterial benefits.

CLAIM 15. I claim as my invention a fermented food for feeding shellfish that is made from a soup made from cooked seaweeds that is inoculated with a selection of naturally occurring probiotic bacteria. This fermented food is useful for conditioning shellfish for breeding and for market as it fattens them and quantitatively overwhelms deleterious bacteria such that they are purged and their niches occupied by the probiotic bacteria in the food. The mucus net formed by the sulfated polysaccharides from the rendered seaweed bundle the bacterial so that the shellfish may capture the bacteria and feed on them. The mucus net assisted feeding on bacteria also assists with the purging of potentially deleterious bacteria by enabling the shellfish to digest them.

CLAIM 16. I claim as my invention a shellfish growing device, a open top marsupium. The mesh-paneled open-top container has more area for exiting water than for entering water so that flow-thru may be sufficient to support a high density of larvae without having the larvae pinned to the exit port mesh. (See Figure 18)

CLAIM 17. I claim as my invention a snag resistant device to resuspend sediment settling on shellfish beds. The device is a swept wing foil on runners towed on the estuary bottom such that sediment lifting vortices are efficiently created. The device will have no load distributing bridle so it may pivot on its tow point in order that it may better escape snags. See Figure 14

CLAIM 18. I claim as my invention the process of using shellfish polyculture to provide cost effective and ecologically advantageous infrastructure benefits to marine landforms: Beaches may be enhanced by using this culture to build the beach foreshore. Shorelines and anchorages may be protected by using this culture to build protective bars and environmentally advantageous groins. See Figure 19

CLAIM 19. I claim as my invention the process of using shellfish polyculture to provide a cost effective and ecologically advantageous means of channel building and/or stabilization. This is accomplished by using this culture to 1) build and stabilize marine landforms adjacent to the channel so as to enhance channel scour, 2) using BUPSY shellfish culture to increase scour and/or hydraulic roughness at strategic points, and 3) using shellfish to armor an eroding channel side or bottom.

CLAIM 20. I claim as my invention the porous lime (calcium carbonate, dolomite, shell hash, etc.) embedded anode used in the electrolytic pH raising (sweetening) of (acidic) water.

CLAIM 21. I claim as my invention the cavitation suppressing marine propeller nozzle that uses the fore and aft extension of the upper portion of the propeller nozzle or shroud to compensate for differences in hydrodynamic pressure with depth while under power. See Figure 9

CLAIM 22. I claim as my invention an aquaculture breeding selection by challenge process useful in the selection of progeny with innate immune competencies that are not c-lectin dependant. The process consists of creating conditions of relative base depletion so that the calcium ion dependant c-lectin functionality will be impaired. The process places the progeny in a flow through containment in natural waters so that the progeny might be exposed to a normally wide range of potential pathogens; Naturally occurring potential pathogen carriers may be seeded in the inflowing water as well. The water flowing into that containment is locally acidified and base ion depleted by means of reversed cathodic protection. On a per challenged individual basis, it is many orders of magnitude cheaper to select by challenging recently hatched progeny than it is to select by challenging adults.

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CLAIM 23. I claim as my invention a permanent (or disposable) mooring and aquaculture anchor with exceptionally high holding power and low weight and cost that has the general shape and function of a detachable harpoon point and is harpooned into the bottom with a wash-pipe. See Figure 10

CLAIM 24. I claim as my invention the process of sprinkler irrigating intertidal shellfish when on the low tide the shellfish would be damaged by hot or cold weather or seabird excreta were it not for the moderating effect of the irrigation. This new process is particularly significant in that it markedly enhances the economics of "finishing" deepwater grown shellfish in inter-tidal locations so that shelf-life and marketability will be enhanced. This new process is also significant in enhancing the economics of using intertidal 'hardening' of nursery-stock shellfish so that they will resist polydora (mud worm) infestation.

CLAIM 25. I claim as my invention a grow-your-own clam predator exclusion net made from the roots of subaquatic vegetation that can replace the high maintenance, high smoother risk, politically vulnerable, plastic clam predator exclusion net.

CLAIM 26. I claim as my invention the shellfish polyculture device of using clam predator exclusion net to raise oysters on top of the net in addition to raising clams under the net.

CLAIM 27. I claim as my invention a process of enhanced cultivation of aquatic vegetation such as Spartina sp. And Zostera sp. by the use of shellfish polyculture to supply the vegetation with fertilizer by means of shellfish excreta.

CLAIM 28. I claim as my invention the crustacean:mollusc polyculture device of using clam predator exclusion net to raise crustaceans like shrimp in combination with molluscs like clams and oysters. This invention is an expansion of customary usage of clam predator exclusion net in which a single "story" clam culture is expanded to a three "story" culture with the crustaceans penned in the middle within predator exclusion mesh and molluscs above and below the shrimp.

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CLAIM 29. I claim as my invention a process of enhancing the cultivation of shellfish by the use of macroalgae and sub-aquatic vegetation (SAV) such as *Zostera mariana* to supply the shellfish with beneficial DOM, enhanced immune and shell building water chemistry, enhanced phytoplankton production and enhanced phytoplankton and bacterioplankton capture.

CLAIM 30. I claim as my invention the use of a horizontal mesh, like clam predator exclusion mesh, to anchor and cultivate marsh grass and a rooted sub-aquatic vegetation (SAV) such as *Zostera mariana*.

CLAIM 31 I claim as my invention panels for constructing a shellfish growing device. These shellfish culture device panels are open frames, approximating a plane, and covered with a disposable impermeable envelope. This envelope will intentionally tear in storm conditions so that further damage can be minimized. The envelope is shed to clear bio-fouling when needed.

CLAIM 32. I claim as my invention a floating shellfish growing device (the Spawntoon assembly) consisting of two classes of pontoon assemblies, a heavier class and a lighter class.. The heavier of the pontoon assemblies may be the lifting and maintenance assembly. The lighter assembly flanks the heavier. The lighter assembly consists of a pontoon with breasting spars. One end of the spar is affixed to the light pontoon and held in breasting position. The other end of the breasting spar is attached to the heavier pontoon assembly so that the lighter pontoon assembly may bob freely on the waves. Dividing the pontoon support into these two assemblies and providing this particular flexible coupling between them is the essence of the utility in this invention claim. (Figure 6)

CLAIM 33. I claim as my invention a water supported live well consisting of 1) an impermeable membrane attached to the rim which bounds the well's contents from the supporting water; and 2) a top rim, ridged enough to establish a consistent elevation of that rim (possibly with the aid of floatation in the rim), to maintain separation between the liquid contents of the well and the liquid supporting the well and supply lifting points. See Figure 8

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CLAIM 34. I claim as my invention a larval capture and draining device used to retain the spawn when a floating hatchery live well is drained by lifting or floatation such that the water is removed near the surface of the water containment even as that water level changes and that the larvae are captured at the inlet of the draining device rather than at the outlet as in the prior practice. This new device makes the water supported live well practical. See Figure 8, Figure 5

CLAIM 35. I claim as my invention a movable stretcher to both support a horizontal algae culture bag over a span, and to provide shade to the spanned region. See Figure 7

CLAIM 36 I claim as my invention a wave agitated floating platform for the agitation and support of phytoplankton/microbiological culture. See Figure 7

CLAIM 37. I claim as my invention the process of mitigating the acid formed in the inevitable process of resuspending of estuarine sediments having a high chemical oxygen demand. Frequent, small, directional, resuspensions of small impact are desirable rather than the catastrophic resuspensions or the randomly directed resuspensions that are more likely to occur in the unmanaged course of natural unless those natural events are preempted with intentional resuspension and capture. All comparable resuspensions are less caustic if the sulfide:carbonate ratio of the sediment is more to the carbonate. The biologically endurable sediment resuspension and transit rate can be higher if the sediments iron sulfide is balanced by an appropriate growth or amendment of calcium carbonate rich marl.

CLAIM 38. I claim as my invention the sequestration of toxic and/or sulfide rich estuarine sediment under a layer of marl or limonite so that previously unproductive and relatively barren estuary bottom may be restored to vigorous health, biotic diversity and shellfish productivity.

CLAIM 39. I claim as my invention a new use and a 'Best Practice' process in the development and management of low flow estuarine canals in a water front real estate development where the liveliness and productivity of the channel is promoted, sedimentation is locally eliminated, stinging nettles are suppressed, phytoplankton diversity enhanced and hazardous dinoflagellate

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Application for Patent on "An Integrated System For Shellfish Production"

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blooms suppressed and the canal turned into a highly productive area for shellfish reproduction. This process is effected by the release of air bubbles from the bottom of the channel such that it creates a continual upwelling and current.

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